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The End of the Moa in Aotearoa

The Lost World of the Moa: Prehistoric Life of New Zealand. Trevor H. Worthy and Richard N. Holdaway. Indiana University Press, Bloomington, IN, 2002. 755 pp., illus. $89.95 (ISBN 0253340349 cloth).

New Zealand, or Aotearoa, the Maori "land of the long white cloud," lies at the southern apex of the Polynesian Triangle in the South Pacific Ocean. In this book, those with an urge to explore "the land that time forgot" can learn what Aotearoa offered before and after our species arrived. The authors of *The Lost World of the Moa* detail the biogeography of 11 species of extinct moa, up to half a ton in weight, which skulked through forest and shrublands like cassowary rather than holding their heads up like an emu or ostrich. In the South Island, a top carnivore, the teratorn-size Haast's eagle, preyed on moa. The roll call of Aortearoa's avian extinctions also includes mysterious flightless adzebills, rails, and wrens.

Aotearoa originated over 56 million years ago, when a land that is now the size of the British Isles split off from Gondwana and, in glorious isolation, evolved diverse terrestrial feeding guilds out of its avifauna. The interior of prehistoric New Zealand had no mammals beyond three bats, two of them ground feeders. The terrestrial fauna included the iguana-size tuatara, small skinks and other small lizards, leiopelmid frogs, and giant flightless insects such as wetas.

In the absence of predatory or scavenging mammals, it is no surprise that natural deposits yield whole skeletons of moa and other birds, along with feathers, dried tissue, eggshells, gut contents, gizzard stones, and tracks. Pyramid Valley and its unusual marsh harbor numerous skeletons of moa and other birds. Judging from the size of fossil moa trachea, some species of moa must have outdone trumpeter swans and whooping cranes in their wild cries.

Worthy and Holdaway trace range changes of the moa and moa habitats back 20,000 years, into the last ice age. Despite accompanying changes in climate, vegetation, and fauna (moa ranges included), the authors report no moa extinctions until very late in the Holocene. "Overchill" fails the test as a cause of moa extinction. Very soon after Polynesian colonization, however, only 700 years ago, moa (the collective noun used by the Maori) vanished. We then see the very last of the devastating prehistoric losses of large animals that began in Australia 50,0000 years ago, struck Japan 20,000 years later, and, just 3000 years ago, swept into the Polynesian triangle to the detriment of many species of birds, especially flightless ones. Worthy and Holdaway believe avian extinctions began in New Zealand 2000 years ago.

Worthy and Holdaway report the surprising extinction of many small animals, including flightless or ground-nesting small birds, before the loss of moa. They suspect that the first people to land in Aotearoa did not colonize. Instead, whether intentionally or not, they left behind a hallmark of things to come, the Pacific rat, *Rattus elegans.* Its bones have been radiocarbon-dated to a time significantly before the settlement of the Maori about 700 years ago. Moa survived until after the extinction of many small animals, doomed by the rats.

On a brief visit to New Zealand in the 1970s for a conference of the International Quaternary Association, I first learned of an unusual discovery. Paleoornithologist Ron Scarlett reported discovering the fossil bones of an extinct owlet-nightjar (Caprimulgidae) that was related to an Australian genus, *Aegotheles.* Although in the same family as nighthawks, whippoorwill, paraque, and other goatsuckers—agile feeders on flying insects—the Australian owlet-nightjars feed on the ground. More robust than its Australian relative, the New Zealand species would have been a poor flier at best and an obligate ground feeder, certainly not in the same niche as North American nighthawks.

In the 1970s paleontologists increasingly adopted the view, which originated with Sir Richard Owen over 100 years earlier, that the moa of New Zealand must have succumbed to human hunting. I imagined that unless some other forcing function could be defended, so did all the other extinct species in New Zealand. But how could an owlet-nightjar, a crepuscular or nocturnal ground feeder, suffer the same fate as the moa? Beyond that, why would moa hunters pay attention to, much less exterminate, even smaller species such as the acanthisittid wrens, flightless passerines?

Worthy and Holdaway report that the new species of owlet-nightjar very likely consumed wetas, New Zealand's giant flightless crickets, along with other giant insects. Along with leiopelmid frogs and the tuatara, the giant flightless insects survive on small offshore islands. What eliminated all of these animals on the large North Island and on the larger South Island of New Zealand?

Worthy and Holdaway indict the Pacific rat as the exterminator of small terrestrial species. The rats wiped out the flightless wrens on the two main islands, as well as the giant insects, indirectly including the stocky caprimulgid in their toll by depleting its food supply. The Pacific rat is a poor swimmer, and as a result near-shore small islands offered a refuge for ground dwelling small species otherwise at risk from rat depredations.

Thus, at least indirectly, the Polynesians triggered all extinctions. Worthy and Holdaway report rat bones radiocarbon dated to roughly 2000 years ago, long

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before the first evidence of colonization by Polynesians themselves. Beyond New Zealand, in at least a few other Pacific islands, small animal extinctions apparently preceded archaeological evidence of Polynesian settlement.

Less than 300 years ago Europeans began to settle in New Zealand, accompanied by many more species of lethal mammals: Norway rats (1772), cats and house mice (1830), black rats (1855), Australian brush-tailed possum (1858), European hedgehog (1870), and European ferrets, weasels, and stoats (1879–1885). Currently, the New Zealand government is struggling valiantly to stop the hemorrhage of extinctions. Those islands not overrun by predatory small mammals offer a potential refuge.

Out of a total fauna of 245 species of prehistoric birds, the list of avian extinctions in the last 2000 years is 66. Extinction struck only three of the 57 species of pelagic marine birds in New Zealand's vast primordial breeding colonies of petrels, storm petrels, shearwaters, and albatross. Nevertheless, with the arrival of the Pacific rat and other mammalian predators, these ground nesters suffered fearful depletion or local extirpation.

Summarizing two decades of full-time work on new fossil excavations, as well as existing collections, and offering an up-to-date account of the biogeography of extinction beginning in the late Pleistocene, Worthy and Holdaway present a richly documented and well-illustrated account of dynamic changes in the late Holocene. The authors are more than entitled to their occasional opinions; for example, "The lack of understanding by many continent-oriented and, it must be added, Northern Hemisphere–trained biologists of both the importance of naïveté and the effects of rat and human predation in island faunas has held back the understanding of the cause of extinction on oceanic islands."

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TROPICAL NATURE PRESERVATION

Making Parks Work: Strategies for Preserving Tropical Nature. John Terborgh, Carel van Schaik, Lisa Davenport, and Madhu Rao, eds. Island Press, Washington, DC, 2002. 511 pp., illus. $65.00 (ISBN 1559639040 cloth).

The intent of the scientist–authors in *Making Parks Work* is to lay out strategies for managing parks (shorthand for "protected areas.") This book is the outcome of a session by conservation professionals to determine how we can protect biological diversity in the 21st century. These researchers wrote 32 chapters that give a broad view of ecological (and financial) park management, considering policy for parks at three levels: that of the individual park and national and international policy.

The book's title is too modest. The lessons of success and failure that are presented can guide the protection of natural areas worldwide, because management strategies in tropical parks—where biodiversity is high and challenges to conservation immense—address broad questions of conservation everywhere. How can parks work at the present and in the future in the face of underfunding, population pressures, social instability, and lack of enforcement? Parks work if they are designed and managed skillfully. One book that addresses the issue of design of protected areas is *Continental Conservation: Scientific Foundations of Regional Reserve Networks,* by Michael Soulé and John Terborgh (Washington, DC: Island Press, 1999). Park management, which is the other half of the challenge, is addressed by Terborgh and his fellow editors in *Making Parks Work.*

John Terborgh is James B. Duke Professor of Environmental Science and Biology in the Nicholas School of the Environment at Duke University, Durham, North Carolina. Terborgh, a tropical ecologist, conducts research in the Manu National Park in Peru. Coeditor Carel van Schaik is a professor of biological anthropology and anatomy at Duke. Terborgh and van Schaik codirect the Center for Tropical Conservation, which is located at the university. The two additional editors are Lisa Davenport, graduate student at the University of North Carolina–Chapel Hill, and Madhu Rao, associate conservation ecologist at the Wildlife Conservation Society at the Bronx Zoo, New York City.

In the early chapters, conservation workers present case studies that are based on fieldwork in Africa, Asia, and Latin America. They analyze how tropical parks have dealt with civil war, agricultural encroachment, illegal logging, commercial hunting for the bushmeat trade (i.e., supplying restaurants with meat of wild animals), underfunding, and corrupt politicians. Specialists will welcome the management particulars that are provided in the country overviews. For example, in West African parks, hunting of large animals rather than destruction of habitat is the greater destructive force to parks (p. 68). In the Congo Basin, logging facilitates access to the parks for illegal hunting, invasion by exotic species, nonsustainable harvest of medicinal plants, and water pollution from mining (p. 76). Researchers point out specific management strategies that have an impact on nature conservation. However, not all strategies work: In many locales, attempts to reconcile development with conservation have not succeeded and, unfortunately, have attracted settlers to move near or into parks. Some strategies do work: in Ranomafana National Park in Madagascar, increased tourism and research generate funds for the park and for its neighbors.

Ivory poaching and the replacement of native forest with oil palm plantations differ mostly in detail from parallel threats that parks face in temperate regions—monoculture tree plantations or poaching of black bear for their gall bladders, for example. The need to garner support from local people, to inform politicians of the biological role of parks, and to attain funding are the shared goals of managers in temperate as well as tropical parks.

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Case studies in Latin America follow the African section. Brazil, for example, balances its promise to expand national parks, ecological stations, and biological reserves to 10 percent of that country's territory with the reality that many Brazilian parks currently are "paper parks" (i.e., unmanaged). In southeastern Peru, the National Sanctuary Pampas del Heath (SNPH) was created by the national government to protect the maned wolf and marsh deer. SNPH endured a rocky existence as a paper park until it was absorbed into the Bahuaja-Sonene National Park. Some of the difficulties encountered by SNPH management included turf struggles between federal and local officials and opposition by the park's neighbors to logging and hunting prohibitions. Meanwhile a Peruvian nongovernmental organization managed the park, with the support of The Nature Conservancy's Parks in Peril (PiP) program.The PiP program approach is to incorporate the neighboring indigenous communities into the management structure of the park, which has helped to overcome some of these adverse attitudes.

In the case study of Costa Rica, the book asks whether the Monteverde Reserve Complex has succeeded in preventing cattle pasture from displacing primary forest. The answer is yes, thanks to skillful management. Costa Rica is a mecca for researchers and ecotourists, because it protects tropical forest in private and public parks nationwide. Monteverde has lost about 30 species of amphibians within two decades. This loss is most likely due to increasingly long dry seasons, a facet of global climate change. Preserving biodiversity in Costa Rica rests on three actions: acquiring wildlife corridors between parks so as to add more habitat types (table 12-2), enforcing park laws fairly, and expanding reserves to ensure that big predators, such as jaguars and harpy eagles, have a sufficiently large area to survive. Jeff Langholz's analysis (chapter 13) of privately owned parks and his case study of these in Costa Rica are particularly timely in view of the current funding crunch for publicly owned protected areas in the United States.

What role does ecotourism play in making parks work? When ecotourism works best, it provides some funds to preserve tropical nature, but national and international subsidies may be required as well. One of the most successful examples of ecotourism is a rain forest park in Madagascar that is blessed with a rich assemblage of endemic fauna and flora—Ranomafana National Park. The golden bamboo lemur, discovered in 1986, and other lemur species drew 12,000 ecotourists to Ranomafana in 1999. What management techniques engendered this success? One technique is to use trained local guides to lead tourists on a rain forest trail, where up to eight lemur species can be observed during a morning's walk. United States and Malagasy university advisers prepared Malagasy park staff in conservation biology and research techniques. Local villagers manage ecotourism, patrols, ecological monitoring, and administration, and the park entrance fee is split 50:50 between local villagers and the park.

Following these case studies, major themes that address conservation strategies for protected areas are admirably organized on three levels: individual parks (enforcement, ecotourism, human–wildlife interaction, land tenure), national (political will, private initiatives, political stability), and international (financing, biodiversity as a global responsibility). "The various constituencies...[of protected areas] must be informed, educated, awarded benefits, or arrested at gunpoint, as appropriate," as Srikosamatara and Brockelman argue on p. 229. The tables in part III, where appropriate tools for park management are arrayed, are a helpful resource.

Most of the 28 black-and-white figures are adequate. A few have infernally minute type (e.g., figure 14-1) or too-similar fill styles (e.g., figure 30-1). I would have welcomed a size scale beside the maps of Costa Rica (figure 12-2) and Sumatra (figure 15-3), as well as a world map. Therefore, the reader may wish to have a world atlas nearby while using *Making Parks Work*. Those who are inspired to implement these strategies for preserving nature will be pleased by the voluminous references and the handy directory of the international cast of contributors.

The only known way to protect ecosystems is to create and preserve protected areas. A zoo may protect elephants from ivory poachers. A botanical garden may protect a medicinal plant from nonsustainable harvesting. But only parks and highly motivated humans can preserve ecosystems. The chapter entitled "Why the World Needs Parks" (by Terborgh and van Schaik, pp. 3–14) should be required reading for all. As the editors intended, this book presents a variety of success stories of parks management fresh from the frontlines. The "principles for effective management of protected areas" are in an easily readable form for managers of protected areas, park rangers, government officials, grant agency personnel, and all who nurture Earth's beleaguered parks.

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ALMOST EVERYTHING IS ABOUT RESTORATION THESE DAYS

Wildlife Restoration: Techniques for Habitat Analysis and Animal Monitoring. Michael L. Morrison. Island Press, Washington, DC, 2002. 209 pp., illus. $25.00 (ISBN 1559639377 paper).

Michael Morrison, field station manager of the University of California's White Mountain Research Station in Bishop, California, and an adjunct professor in the School of Forestry at Northern Arizona University, is thoroughly qualified to write about techniques for analyzing habitat and monitoring animals: He has written extensively about the concepts and terminology of habitat and is the coauthor of *Wildlife: Habitat Relationships*

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(Madison: University of Wisconsin Press, 1998) and *Wildlife Study Design* (New York: Springer-Verlag, 2001).

In *Wildlife Restoration: Techniques for Habitat Analysis and Animal Monitoring,* Morrison seeks to to expand the concept of restoration beyond the rehabilitation of damaged sites to the conservation and stewardship of lands and their wildlife. A second purpose is to convey the message that restoration of all types is a scientifically rigorous undertaking. Morrison warns the reader to take the subject seriously, apparently aware of the high incidence of half-baked restoration projects. For restoration to succeed, Morrison advises, people must sit and think long and hard before they race out of the door. That is one lesson among many from the book that is relevant everywhere, although most of the examples Morrison uses are from the western United States, specifically San Diego County.

Morrison starts the book with the traditional concept of restoration as something done to repair damaged lands. He points out that restoration of vegetation is often undertaken to create "wildlife habitat," although this goal is usually not spelled out in a project's success criteria or monitoring program. What constitutes wildlife habitat must be defined specifically and consistently, the author rightly argues. Morrison then leads the reader through a maze of frequently misused concepts such as habitat quality, habitat availability, and habitat use. I would have liked to see the section in the second chapter on how spatial scale affects project goals expanded to consider more of the complications that make developing those goals so difficult. While restoration goals for, say, a salamander may automatically suggest goals and research at a small scale (watersheds notwithstanding), I think large-scale projects that have goals such as "increased species richness" should address a combination of large- and small-scale goals. This is because much of that species richness will come from small organisms that use resources at a small scale (another example of how wildlife restoration is a complicated business).

Throughout the book, Morrison repeats his recommendation that unambiguous goals should be established at the start of a project, and this cannot be said too often. It is a practice that wildlife agencies should adopt in their own projects and in those they review. When reading this book, you get the feeling that Morrison has seen many restoration projects flounder and is familiar with failures to which restorers have often turned a blind eye. The savvy ecologist should not be put off by Morrison's admonitions to increase rigor, but be glad he is lecturing people on such an important matter.

The success of restoration projects depends on the development of and adherence to a rigorous study design.

Morrison provides an almost dizzying array of techniques and issues for the reader to consider. This may have been done to illustrate the complexity of restoration projects. I was pleased he mentions that the success of restoration projects depends on the development of and adherence to a rigorous study design, that monitoring is research, and that inventories are not quick-and-dirty surveys. However, I would have preferred his cautions about potential technical pitfalls in monitoring to be more powerful. I would also have welcomed a stronger stand on issues such as the importance of thinking about variables before you choose them, the assumptions associated with the use of indices and indicators, and the problems with using habitat as a surrogate for population status and trends (we rarely have a firmly documented link between the two). Some

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case studies on the results of these misuses would have been useful here. Morrison is a persuasive writer, and I hoped to see the same firmness that he admonishes the ecologist to use when thinking about habitat applied to some of these other issues.

Despite the wealth of facts that are presented for readers to consider, there were some gaps in the book. The approximately three pages on how to minimize observer bias in chapter 2 do not mention techniques for estimating the probability of detecting individuals (Lancia et al. 1996), though Morrison and colleagues emphasized this design issue in another publication (2001), and it would have been useful to have it described in this book as well. Additionally, a mention of the emerging use of information-theoretic approaches to analysis and modeling (Burnham and Anderson 2002) would have been useful in the section about modeling in chapter 5.

If you have been frustrated when communicating to others why restoration of any kind requires rigor ("We'll track vegetation to see how the species are doing" is a refrain heard too often), Morrison is sympathetic. His book can provide some useful words for making your case.

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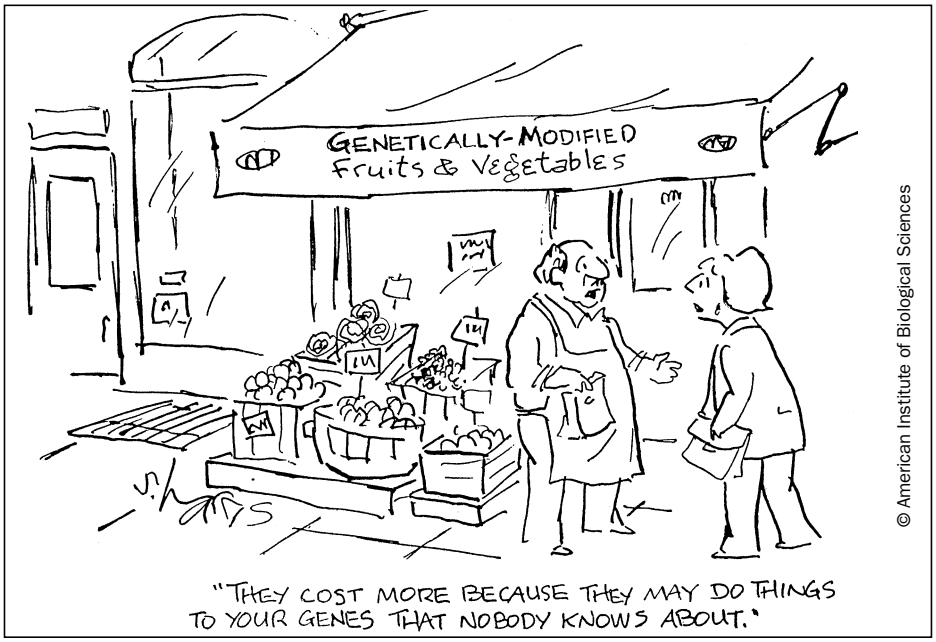
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